

## RISK ASSESSMENT OF SUPPLIERS (SMES) FROM CUSTOMER'S PERSPECTIVE BY CLUSTER ANALYSIS

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### ABSTRACT

*SME performance has been receiving increased attention because of a need to address sustainability issues of tier-1 companies in the ever-growing market. In this paper, the authors have used a comprehensive data questionnaire validated by academia and industry experts for this empirical investigation. The SMEs are grouped into clusters based on the identification of manufacturing processes and performance measures. Factors that affect the measure of performance of an SME are analyzed to give a judgement on quality, dependability, and performance achievable aspects. The analysis is done using SPSS software and the most significant factors that influence the clusters are determined. The factors that need to be focused on, to improve the performance of SMEs are studied. With the make in India initiative this study helps to attain certain key tools and on how to tackle the issues faced by SMEs with the help of the suggested mitigation strategies.*

**KEYWORDS:** Cluster, Risk management, Small and Medium Enterprises (SMEs), Small and Medium Enterprises Performance, Suppliers, Statistical Package for Social Science (SPSS), Tier I

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### INTRODUCTION

In today's competitive world, it is quite necessary to have an effective and efficient process of manufacturing that most global enterprises focus on reducing the cost of raw materials and labour to yield higher revenue by neglecting various risks involved. Supply chain management is the study or analysis of oversight of materials, information, and finances as they move in a process from supplier to consumer. Small and medium-sized enterprises have played a significant role in the development of all counties. SME's (less than 200) contribute to more than 50 percent of the value added by the industry to gross domestic product [6]. SMEs in the developed countries contribute substantially to the county's growth. SMEs of the developing countries although lagging behind contribute positively. For instance, SMEs account for about 45% of the manufacturing value-add in Bangladesh. They account for about 80% of industrial employment, about 90% of total industrial units and about 25% of the total labour force. Their total contribution to export earnings varies between 75% and 80%. SME's success significantly contributes to the economic prosperity of the nation. Researchers have determined the numerous factors that determine the success, or otherwise, of SMEs. These include the entrepreneur, their innovation and learning orientations, , skills and motivation [13].

Over the last five decades, Small and Medium Enterprises (SME) sectors in India has emerged as a highly important and dynamic sector of the Indian economy. They play a crucial role in providing large employment opportunities at comparatively lower capital cost than large industries and help in the industrialization of rural areas. SMEs support large industries as ancillary units and this sector contributes a lot the socio-economic development of the country. The Sector consisting of 36 million units, as of today, provides employment to over 80 million persons. The Sector through more than 6,000 products contributes about 8% to GDP besides 45% of the total manufacturing output and 40% to the exports from the country. SMEs in India are also facing a number of problems like sub-optimal scale of operation, technological obsolescence, supply chain inefficiencies, increasing domestic & global competition, working capital shortages, not getting trade receivables from large and multinational companies on time, insufficient skilled manpower, change in manufacturing strategies and turbulent, and uncertain market scenario even though they have very high enthusiasm and inherent capabilities to grow [18],[2].

Supply chain risk management (SCRM) has emerged as an issue of critical importance for today's global supply chains. Various supply chain disruptions have been in the headlines for the most part of the decade. Further, a number of major trends such as globalization, outsourcing, a transition to lean and agile operations have contributed to the importance of SCRM [4],[19]. Companies often face the situation where the supplier will be unable to deliver as promised [11]. The stopping of production of several automotive companies is a well-known example. To survive with such issues and compete with large and global enterprises, SMEs need to adopt innovative approaches in their operations. Since it is a modeling based cluster approach which allows the assessment of appropriate number of classes it provides a more reliable estimation of business model configurations than traditional cluster analysis [20]

## **LITERATURE REVIEW**

Focusing on SME's difficulties has helped scholars determine what needs to change to make SME's less skewed towards large industries [15]. Most empirical studies that analyze dynamic capabilities in an SME are based on manufacturing industries [1]. To the best of our knowledge, no academic paper has yet specifically dealt with strategic agility in SMEs and there are differences when the results were compared to the findings for strategic agility in large companies. However, previous literature on business models finds significant differences between SMEs and large companies [7]. As asserted at the outset, there has been a tendency to assume that SME's are homogenous about their attributes, behaviors and even experienced outcomes in public procurement [6]

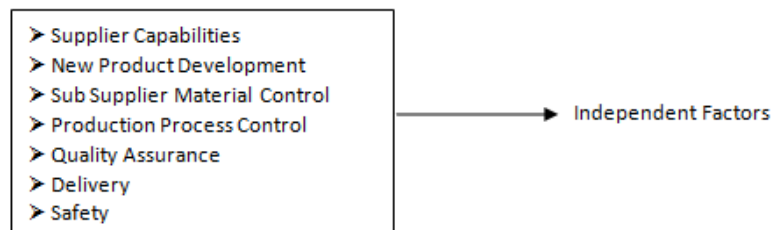
From a study of German firm supplying to India, it was suggested that the firms need to innovate and adapt their business model to better fit the market of the nation [16]. An SME's learning capacity rests on three factors which underpin adaptive and generative learning. The business models adopted by SMEs for foreign markets are not the same as those applied for domestic markets. Supplying for foreign markets requires decision-makers to consider numerous factors such as how to do business across national borders, which export channels to use, different competitive and institutional conditions may require an adoption of business models developed for domestic markets to suit foreign market contexts [21]

The risk is a situation in danger and managing it is the key to success in any enterprise. Enterprise risk management (ERM) is a relatively new discipline which focuses on identifying, analyzing, monitoring, and controlling all major risk classes like credit, market, liquidity, operational risk classes and solving this to have the efficient system [9]. Both external factors like the legal and regulatory environment and the overall labour market and internal factors like organizational design

and personnel management practice) contribute highly to increasing risk associated with production dependent on hiring labour [9]. The impact on slight changes in the environment of the working class show major differences in supply operations and working [9]

In the growing body of literature on marketing in small and medium firms (SMEs), numerous studies have suggested that the marketing performance of an SME can be improved if such firms make proactive use of the business networks in which they are embedded [2],[3]. In conceptually unexplored fields, the cluster analysis advocates the selection of passive cluster variables that enable a rich description of characteristics of the identified clusters [12]. It is found that through networking with other firms, individual SME owner-managers can address their individual resource limitation problems [5], as well as improve their marketing activities [8]

Although these studies explain the marketing performance effects of the personal networks of individual SME owners, it is argued that similar dynamics and effects may hold true for the members of whole clusters. It has been determined in the past that the markets performance is very important to overall firm performance, including amongst SMEs [14] [17], being manifest in indicators such as strong brand awareness, expressions of customer preference, and elevated levels of market share [10]



**Figure 1: Framework Model**

The increasing numbers of research studies on supply chain disruptions resulting from economic and political instability, volatile market dynamics, natural disasters or human actions, have shown that risk issues are becoming the new norm in supply chain operations.

## **RESEARCH FRAMEWORK**

### **Research Objective**

The main objective of this paper is to analyses supply chain issues faced by the TIER-I companies, due to their suppliers (SMEs). The comprehensive study keeps trend of current and future needs for excellence in SMEs performance from TIER-I perspective.

### **Questionnaire Development**

The Questionnaire was prepared with the help of top industrial and academic experts as a pilot study. Their valuable inputs were taken into consideration to make the categories of the questionnaire. Our questions include:

- The identification of the Risk
- How to assess a supplier's capabilities, goals, targets, managerial skills, depth in key groups and what is outsourced.

- Focus on the capacity of the supplier's operation, plant, equipment, time, backup suppliers, output ratios and other factors that can affect their abilities to perform to contract.
- Supplier's ability to put words into action.
- Assessing a supplier's financial prowess & capital investment
- Long-term contract with suppliers; vision, outlook, and future direction of alliance partners.

### Framework of Conceptual Model

The critical factors which determine the performance of SMEs from Tier-I perspective that are taken into consideration. These factors is represented in the Fig. 1

The critical factors are characterized and influenced by its items listed in the Table 1

**Table 1: Factors Description**

Factors	Abbreviation	No.of Items
Supplier Capabilities	SC	17
New Product Development	NPD	6
Sub Supplier Material Control	SS	8
Production Process Control	PPC	14
Quality Assurance	QA	4
Delivery	DE	3
Safety	SF	3

## INDEPENDENT FACTORS

### Supplier Capabilities

This is defined as the ability of the company to the OEM quality with a help of a talented management. Thus, the short-term requirements such as cost, quality, and service along with other short-term criteria must be met.

### New Product Development

(NPD) covers the complete process of bringing a new product to market. New product development is described in the literature as the transformation of a market opportunity into a product available for sale.

### Sub Supplier Material Control

To develop an effective partnership, it is necessary to have a small supply base and the supply base should be reduced to a manageable level. The relationship between the supplier and the company should be healthy for effective functioning. Any organization looks for quality input (materials) from suppliers to have the desired output or use.

### Production Process Control

Process control is defined as the discipline that deals with mechanisms, architectures, and algorithms to maintain a consistent output for the desired process. The layout of the process is understood in Production Process Planning.

### Quality Assurance

Quality assurance (QA) is a way of averting mistakes or defects in manufactured products and avoiding problems when delivering solutions or services to customers to satisfy the quality requirements. It refers to the service of a product.

### **Delivery**

Delivery performance provides an indication of how successful the supply chain is at providing products and services to the customer. The study of effective processes for delivery and disposition of goods and personnel is called logistics.

### **Safety**

Process safety helps companies implement various safety measures that prevent accidents, and sudden breakdowns. The tools used to enable the identification, elimination, reduction and mitigation of risks resulting from the operation.

### **Data Collection**

#### **Empirical Investigation**

The questionnaire was circulated to 55 SMEs under 5 Tier-I Auto component manufacturing companies. Out of which 49 SMEs responded and data was collected. These data were collected from the Quality Assurance department, who oversees vendor quality. Based on this study the SMEs were grouped based on their operations such as Machining and Molding that are considered as clusters and this is displayed in table 2

**Table 2: Cluster Classification**

Cluster	Operation	SMEs
C1	Moulding	16
C2	Machining	15

### **Validity and Reliability Analysis**

Reliability is the extent to which the instrument measures the intended issue consistently. Using reliability analysis, the relationship of each item in the questionnaire is analyzed, and an overall index of the repeatability or internal consistency of the scale can be recognized and the elimination can be done based on problematic items. In this method, reliability is operationalized as internal consistency, which is the degree of intercorrelations among the items that constitute a scale.

#### **Face Validity**

Face validity is a mere appearance that a message is valid. A measure is often considered to have face validity if the items are reasonably related to the perceived purpose of the measure. Face validity is also established through a thorough review of the questionnaires by experts, both academic and practitioners, in the field.

#### **Content Validity**

Content validity is a subjective assessment of how appropriate the instrument seems to a group of reviewers with knowledge of the subject matter.

### **Statistical Tools for Analysis**

SPSS is a widely used program for statistical analysis in social science.

- **Reliability Test:** Reliability analysis allows you to study the properties of measurement scales and the items that compose the scales. **Cronbach's Alpha** is a model of internal consistency and based on the average inter-item correlation. A value of above 0.7 is considered a credible Questionnaire.
- **Factor Analysis:** Factor analysis is a statistical method used to describe variability among observed, correlated

variables in terms of a potentially lower number of unobserved variables called factors.

- **Correlation Analysis:** Correlation analysis is a method of statistical evaluation used to study the strength of a relationship between two, numerically measured, continuous variables (e.g. height and weight). This analysis is useful when a researcher wants to establish if there are possible connections between variables.
- **Regression Analysis:** In statistical modeling, regression analysis is a statistical process for estimating the relationships among variables.
- **Paired t-Test:** The paired t-test has been used for this analysis. A paired t- test is a statistical test which is performed to determine if there is a reliable difference between two means.

## DATA ANALYSIS

### Reliability Analysis

Using SPSS software, we analyzed the data of 49 SMEs and performed reliability test. The reliability test was carried out for each factor in Cluster 1 and Cluster 2 and the corresponding Cronbach's alpha value for all factors are displayed in Table 3

**Table 3: Cronbach's Alpha Value**

Items	Cronbach's Alpha	
	Cluster 1	Cluster 2
SC	0.758	0.892
NPD	0.787	0.889
SS	0.733	0.922
PPC	0.707	0.915
QA	0.715	0.889
DE	0.713	0.724
SF	0.787	0.746

The questionnaire is valid as the Cronbach 's alpha is greater than 0.7 in all the factors and items. Since the questionnaire is valid, detailed analysis can be done.

**Table 4: Factor Loading**

Supplier Capabilities																
	SC2	SC3	SC4	SC5	SC6	SC7	SC8	SC9	SC10	SC11	SC12	SC14	SC15	SC16	SC17	
C1	-	0.72	-	-	-	-	0.88	0.55	-	-	0.72	-	-	-	0.81	
C2	0.47	-	0.56	0.67	0.81	0.63	0.65	0.74	0.40	0.76	0.82	0.50	0.40	0.62	0.85	
New Product Development																
	NP1			NP2			NP3			NP4			NP5		NP6	
C1	0.824			0.725			0.668			-			-		-	
C2	0.836			0.870			0.880			0.899			0.770		0.546	
Sub Supplier Material Control																
	SS1		SS2		SS3			SS4		SS5		SS6		SS7		SS8
C1	-		-		0.687			0.887		0.700		-		-		-
C2	0.841		0.795		0.790			0.814		0.920		0.684		0.894		0.695
Production Process Control																
	PPC1	PPC2	PPC3	PPC4	PPC5		PPC6	PPC7	PPC8	PPC9	PPC10	PPC12	PPC13	PPC14		
C1	-	0.895	-	-	-		-	0.837	-	-	-	-	0.739	0.415		
C2	0.618	0.508	0.789	0.651	0.844		0.918	0.489	0.873	0.690	0.631	0.738	0.654	0.730		
Quality Assurance																
	QA1				QA2				QA3			QA4				
C1	0.833				0.532				-			0.867				
C2	0.840				0.901				0.973			0.849				
Delivery																

Table 4: Contd.,			
	DE1	DE2	DE3
C1	0.850	0.850	
C2	0.877	0.886	0.634
Safety			
	SF1	SF2	SF3
C1	-	0.841	0.841
C2	0.859	0.859	-

## Factor Analysis

### Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is a statistical technique used to verify the factor structure of a set of observed variables. CFA helps the researcher to test the hypothesis that a relationship between observed variables and their underlying latent constructs exists.

### Exploratory Factor Analysis

Exploratory factor analysis (EFA) is an orderly simplification of interrelated measures. EFA, traditionally, has been used to explore the possible underlying factor structure of a set of observed variables without imposing a preconceived structure on the outcome.

**CFA and EFA** are similar techniques, but in exploratory factor analysis (EFA), data is simply explored and provides information about the numbers of factors required to represent the data.

The value of the mean of each of the seven categories were made as variables and the components were the SMEs. The above data was analyzed with the help of Factor Analysis using SPSS software.

### CFA Analysis is Suitable for this Empirical Investigation

Factor analysis for C1 and C2 are displayed in table 4

### Correlation Analysis

This analysis helps comprehend the degree of association between the factors and their relationship with each other. Initially, a hypothesis is framed and tested.

### Hypothesis

- **H<sub>1</sub>C<sub>1</sub>**: There is a strong positive relationship among all the factors of Cluster 1
- **H<sub>1</sub>C<sub>2</sub>**: There is a strong positive relationship among all the factors of Cluster 2

**Table 5: Correlation Analysis For Cluster 1**

Cluster 1							
	SC	NPD	SS	PPC	QA	DE	SF
SC	1						
NPD	0.268	1					
SS	0.640**	0.488	1				
PPC	0.420	0.418	0.231	1			
QA	0.476	0.158	0.198	0.268	1		
DE	0.109	0.127	0.138	0.050	0.012	1	
SF	0.092	0.095	0.043	0.130	0.402	0.288	1

\*\* - Correlation is significant at 0.01 level (2 - tail)

\* - Correlation is significant at 0.05 level (2 - tail)

**Table 6: Correlation Analysis for Cluster 2**

Cluster 2							
	SC	NPD	SS	PPC	QA	DE	SF
SC	1						
NPD	0.136	1					
SS	0.667**	0.394	1				
PPC	0.868**	0.072	0.552*	1			
QA	0.602*	0.536**	0.865**	0.423	1		
DE	0.402	0.484	0.601*	0.330	0.507	1	
SF	0.390	0.110	0.470	0.189	0.388	0.224	1

\*\* - Correlation is significant at 0.01 level (2 - tail)

\* - Correlation is significant at 0.05 level (2 - tail)

## RESULTS OF HYPOTHESIS

Correlation analysis for the respective clusters is displayed in table 5 and table 6. From the C1 correlation analysis, it clearly evident that only Sub Supplier Material has a strong influence on supplier capabilities, hence  $H_1C_1$  is rejected. From the C2 correlation analysis, Sub Supplier, Production Process Control, and Quality Assurance have a strong influence on Supplier Capabilities, Quality Assurance and Delivery has a strong relationship on Sub Supplier Material Control, hence  $H_1C_2$  is rejected.

From the above hypothesis and conclusion, we infer that all the factors are independent of each other.

## Regression Analysis

### Cluster 1

After factor analysis, regression analysis was carried out on 7 factors taken as independent variables and SME performance is taken as dependent variables and a regression mathematical model is derived.

$$\begin{aligned}
 SME_{Perf.} = & 0.575(SC) + 0.884(NPD) \\
 & + 0.019(SS) + 0.136(PPC) + 0.221(QA) + 0.168(DE) \\
 & + 0.613(SF) + 2.972
 \end{aligned} \quad (1)$$

Based on this equation we get to know that; factors NPD and SF have the highest coefficients. So, to improve their standing with Tier I companies, the SMEs should focus more on these aspects.

### Cluster 2

The regression analysis was also carried out for cluster 2 and a regression mathematical model is derived.

$$\begin{aligned}
 SME_{Perf.} = & 0.019(SC) + 0.094(NPD) \\
 & + 0.169(SS) + 0.496(PPC) + 0.148(QA) \\
 & + 0.103(DE) - 0.261(SF) + 2.018
 \end{aligned} \quad (2)$$

Based on this equation we get to know that; factors SS and PPC have the highest coefficients. So, to improve their standing with Tier I companies, the SMEs should focus more on these aspects.

## Paired T-Test

Paired t-test gives the overall dependency between two categories in the questionnaire, taking hypothesis at 95 percent significant level. A hypothesis is framed and tested. Table 7 indicates all paired t-test values.



## Hypothesis

- $H_{sc}$ : There is a significant difference between C1 and C2 with reference to SC.
- $H_{npd}$ : There is a significant difference between C1 and C2 with reference to NPD.
- $H_{ss}$ : There is a significant difference between C1 and C2 with reference to SS.
- $H_{ppc}$ : There is a significant difference between C1 and C2 with reference to PPC.
- $H_{qa}$ : There is a significant difference between C1 and C2 with reference to QA.
- $H_{de}$ : There is a significant difference between C1 and C2 with reference to DE.
- $H_{sf}$ : There is a significant difference between C1 and C2 with reference to SF.

From the paired t-test analysis, it was confirmed that Sub Supplier Material Control and Safety is significant which are highlighted in table 7. Hypothesis  $H_{ss}$  and  $H_{sf}$  are accepted which insists that the two clusters have differences only on Sub Supplier Material Control and Safety factors.

**Table 7: Paired t-test**

Moulding Cluster	Machining Cluster														
	SC		NPD		SS		PPC		QA		DE		SF		
	T	sig	t	sig	t	sig	t	sig	t	sig	t	sig	t	sig	
	SC	1.339	0.202	0.641	0.532	1.165	0.264	0.336	0.742	-0.561	0.584	-1.742	0.103	3.034	0.009
	NPD	2.214	0.044	0.924	0.371	1.624	0.127	1.187	0.255	-0.55	0.957	-1.395	0.185	3.829	0.002
	SS	2.902	0.012	1.924	0.075	2.396	0.031	2.012	0.064	0.834	0.418	-0.226	0.824	4.294	0.001
	PPC	2.205	0.045	1.124	0.280	1.905	0.078	0.851	0.409	-0.215	0.833	-1.760	0.100	4.559	0.000
	QA	1.465	0.167	1.408	0.183	1.433	0.175	0.750	0.467	0.132	0.897	-1.085	0.298	3.137	0.008
	DE	0.576	0.574	0.044	0.966	0.612	0.550	0.213	0.834	-0.906	0.380	-1.683	0.115	2.442	0.028
SF	1.202	0.249	0.612	0.551	1.190	0.254	0.404	0.693	-0.335	0.743	-1.549	0.144	3.086	0.008	

## RESEARCH SUMMARY

The research has been comprehensive keeping in mind the current and future needs in excellence in the performance of SMEs from a tier I perspective. The salient ones are

- 49 SMEs were classified into 2 clusters.
- Seven most important categories which govern the performance of SMEs from tier I perspective was identified. The most important categories were found out for each cluster using factor loading.
- A correlation analysis was done for each cluster this helps to identify several factors in groups sharing similar features.
- The most important subcategory was found out using regression analysis.
- These two clusters were compared with each other using paired t-test to find out the most significant factor.

## CONCLUSIONS

Although there is an increasing amount of attention paid in the field of Supply chain management practices by practitioners and academicians, failures in effectively handling and implementing SCM still do exist. This analysis has given a holistic view of the various issues to be considered by the SMEs for excellence in performance by creating models for each of the two clusters. The factor analysis and regression analysis has been employed to help the SMEs to identify potential areas

for improvement from the tier I perspective lucidly and objectively.

The research attempts to define the relationship between performance and productivity. This same research model can be extended to any type of small and medium enterprises that fall outside the two clusters analyzed here. Research and development in this area are cumbersome. A clear insight would have been possible if the number of responses was large and proper. Unfortunately, a larger survey is not possible due to limited resources and technical issues, another restraint of this study is that of SMEs from India were surveyed, as a scope for a further research much larger survey can be attempted with SMEs from various countries for a much-generalized result.

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